Continuous Database Monitoring with the Trace API

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The SCCH is an initiative of

JOHANNES KEPLER UNIVERSITÄT LINZ
Netzwerk für Forschung, Lehre und Praxis

The SCCH is located at

softwarepark hagenberg

Agenda

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- **Motivation**
- Monitoring Approaches
- Firebird 2.5 Audit and Trace Services
- Usage of fbtracemgr
- FB TraceManager 2
- Q&A

Motivation

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- Several stakeholders for database monitoring
  - Administrators
  - Developers
  - Auditors
  - ...
- A snapshot (MON$) of current activities is interesting. But, most of the time you need the history of executed events
- Continuous monitoring gives you a stream of executed events over a period of time and lets you look back
- A new way to detect and diagnose problems
- The **Audit and Trace Services API in Firebird 2.5** provides that!!!

Motivation

- Typical use cases for the **Audit and Trace Services API**
  - Number of executed statements for a particular time period
    - Usage statistics for load planning
  - Block-box debugging
    - Execution trace for an in-house / third-party product
    - For third-party products, usually you don‘t have access to the client source code
    - No need for adding trace logic into the client application
  - Detection of
    - Failed / Unauthorized access
    - Certain event types
    - Improper client transaction management (e.g. Regular usage of COMMIT RETAINING)
    - Full table scans

Motivation

- Typical use cases for the **Audit and Trace Services API**
  - Detection of (continued)
    - Most-Frequently executed statements
    - Worst-Performing executed statements
    - Executed statements which are slower than a given threshold (e.g. 5 seconds)
  - Statistics
    - Number of statements per IP / process name / user ...
    - Most loaded database on the server
    - When are usual peak loads
    - ...
  - Generated trace as input for a security audit
  - **AND MORE ... !!!**

Motivation

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Quick Start Demonstration

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Monitoring Approaches

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- Basic monitoring requirements
  - Continuous
  - Server-side
  - Configurable
- Three out-of-the box monitoring approaches in Firebird 2.5
  - Trigger-based (since Firebird 1.0)
  - Monitoring tables (since Firebird 2.1)
  - Audit and Trace Services (since Firebird 2.5)
- Based on your monitoring requirements, you possibly will have/use a mix of these approaches

Monitoring Approaches Comparison

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	Trigger-based	Monitoring tables	Audit/Trace Services
Available since Firebird version	1.0	2.1	2.5
Continuous	Yes	No	Yes
Serverside	Yes	Yes	Yes
Configurable	Yes	No	Yes
Monitoring of SELECT	No	Yes	Yes
Monitoring of DELETE, INSERT, UPDATE	Yes	Yes	Yes

Monitoring Approaches Comparison

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	Trigger-based	Monitoring tables	Audit/Trace Services
Access to old/new column values for DELETE, INSERT, UPDATE	Yes	No	No
Access to statement execution time	No	No	Yes
Access to statement execution plan	No	No	Yes
Monitoring of database-wide operations like connect, disconnect, transaction start etc.	Partly (database triggers in Firebird 2.1)	Partly	Yes

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Audit and Trace Services
General

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- New feature in Firebird 2.5 across all architectures and supported platforms
- Allows to produce a trace of events in chronological sequence
- Event types
  - Database-specific
    - Connect, Disconnect
    - Start/Commit/Rollback of transactions
    - Prepare/Start/Finish/Free of SQL statements
    - Start/Finish of stored procedures and triggers
    - etc.
  - Server-wide
    - Services API requests (e.g. backup, restore, get server log etc.)

Audit and Trace Services
System Audit vs. User Trace

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- System Audit
  - Will be started by the engine upon Firebird server start
  - Stores trace output in a text file on the server
  - Is activated by setting the new *AuditTraceConfigFile* parameter (= path to the trace configuration file) in *firebird.conf*
  - There can be only one system audit per Firebird instance
- User Trace
  - Needs to be started by a user manually
  - Trace output is read by the initiating application fetching trace data via the Services API
  - Needs to be re-started after a server crash/restart
  - There can be several user traces per Firebird instance

Audit and Trace Services
Trace Output

- Implemented by the pre-installed fbtrace(.dll|.so) plugin

```
Trace session ID 1 started
2010-11-10T22:26:00.4160 (1368:0000000000F1DC88) TRACE_INIT
   SESSION_1 FBTM - tourism


2010-11-10T22:26:00.4160 (1368:0000000000F1DC88) ATTACH_DATABASE
   tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
   C:\Program Files (x86)\Upscene Productions\Database Workbench 4
   Pro\DBW4.exe:3768

2010-11-10T22:26:00.4220 (1368:0000000000F1DC88) START_TRANSACTION
   tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
   C:\Program Files (x86)\Upscene Productions\Database Workbench 4
   Pro\DBW4.exe:3768
        (TRA_24395, READ_COMMITTED | REC_VERSION | NOWAIT | READ_WRITE)

2010-11-10T22:26:00.4860 (1368:0000000000F1DC88) PREPARE_STATEMENT
   tourism.fdb (ATT_1415, TOURISM:NONE, NONE, TCPv4:127.0.0.1)
   C:\Program Files (x86)\Upscene Productions\Database Workbench 4
   Pro\DBW4.exe:3768
        (TRA_24395, READ_COMMITTED | REC_VERSION | NOWAIT | READ_WRITE)
```

Audit and Trace Services
Trace Configuration

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- A system audit / user trace is configurable by providing a mandatory trace configuration (file)
- Customization of
  - Database-wide events
    - Connect, disconnect, prepare statement etc.
  - Server-wide events
    - Services API requests
- Consists of
  - Default <database> section
  - <database db_name_pattern> section per database
  - Max. one <services> section for server-wide events
- Pre-installed *fbtrace.conf* is a good start for writing your own trace configuration

Audit and Trace Services
Trace Configuration

- A very simple example

```
<database>
   enabled true
</database>

<database employee.fdb>
   enabled false
   log_connections true
   log_transactions true
</database>

<database tourism.fdb>
   log_connections true
</database>
```

Audit and Trace Services
Trace Configuration

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- <database> configuration parameters
  - enabled, log_filename, max_log_size, include_filter, exclude_filter, log_connections, connection_id, log_transactions, log_statement_prepare, log_statement_free, log_statement_start, log_statement_finish, log_procedure_start, log_procedure_finish, log_trigger_start, log_trigger_finish, log_context, print_plan, print_perf, log_blr_requests, print_blr, log_dyn_requests, print_dyn, time_threshold, max_sql_length, max_blr_length, max_dyn_length, max_arg_length, max_arg_count
- <services> configuration parameters
  - enabled, log_filename, max_log_size, include_filter, exclude_filter, log_services, log_service_query

Audit and Trace Services
Manage Trace Sessions

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- Trace Sessions can be managed via new Services API calls

Action	Services API call
Start a new user trace session	isc_action_svc_trace_start
Stop a trace session	isc_action_svc_trace_stop
Suspend a trace session	isc_action_svc_trace_suspend
Resume a trace session	isc_action_svc_trace_resume
List all trace sessions	isc_action_svc_trace_list

Audit and Trace Services Security

- Every user can start a trace session
- Used user name upon attaching to the services manager defines
  - Privileges in respect to managing other trace sessions
  - Visibility of traceable statements
- Privileges
  - SYSDBA can manage all other trace sessions including a system audit
  - Non-SYSDBA users can manage their own trace sessions only
- Visibility
  - A user trace session started by SYSDBA logs activities of all users/connections
  - A user trace session started by a non-SYSDBA user logs only its own activities

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Usage of fbtracemgr

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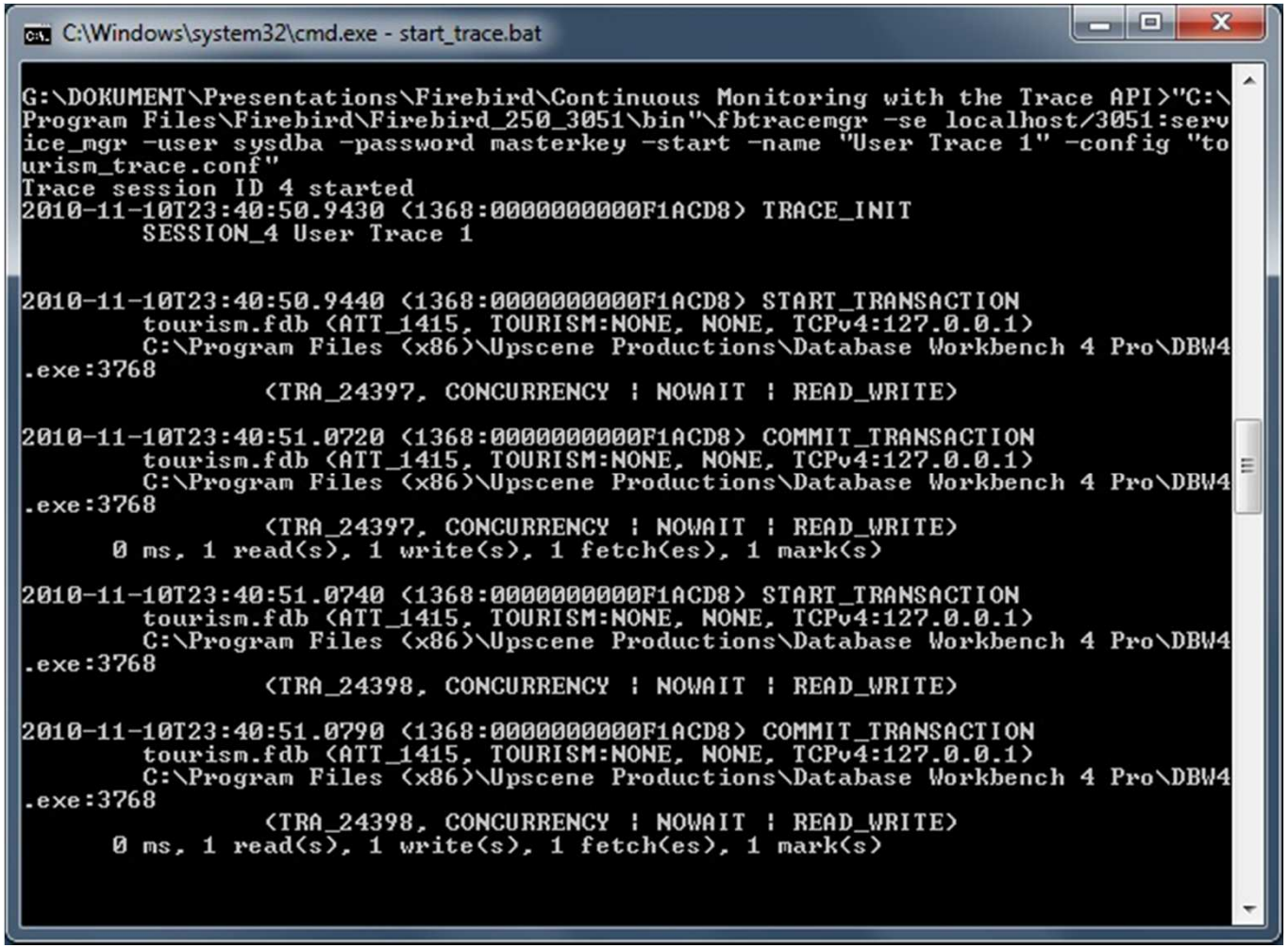

Usage of fbtracemgr

Live Demonstration

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FB TraceManager 2

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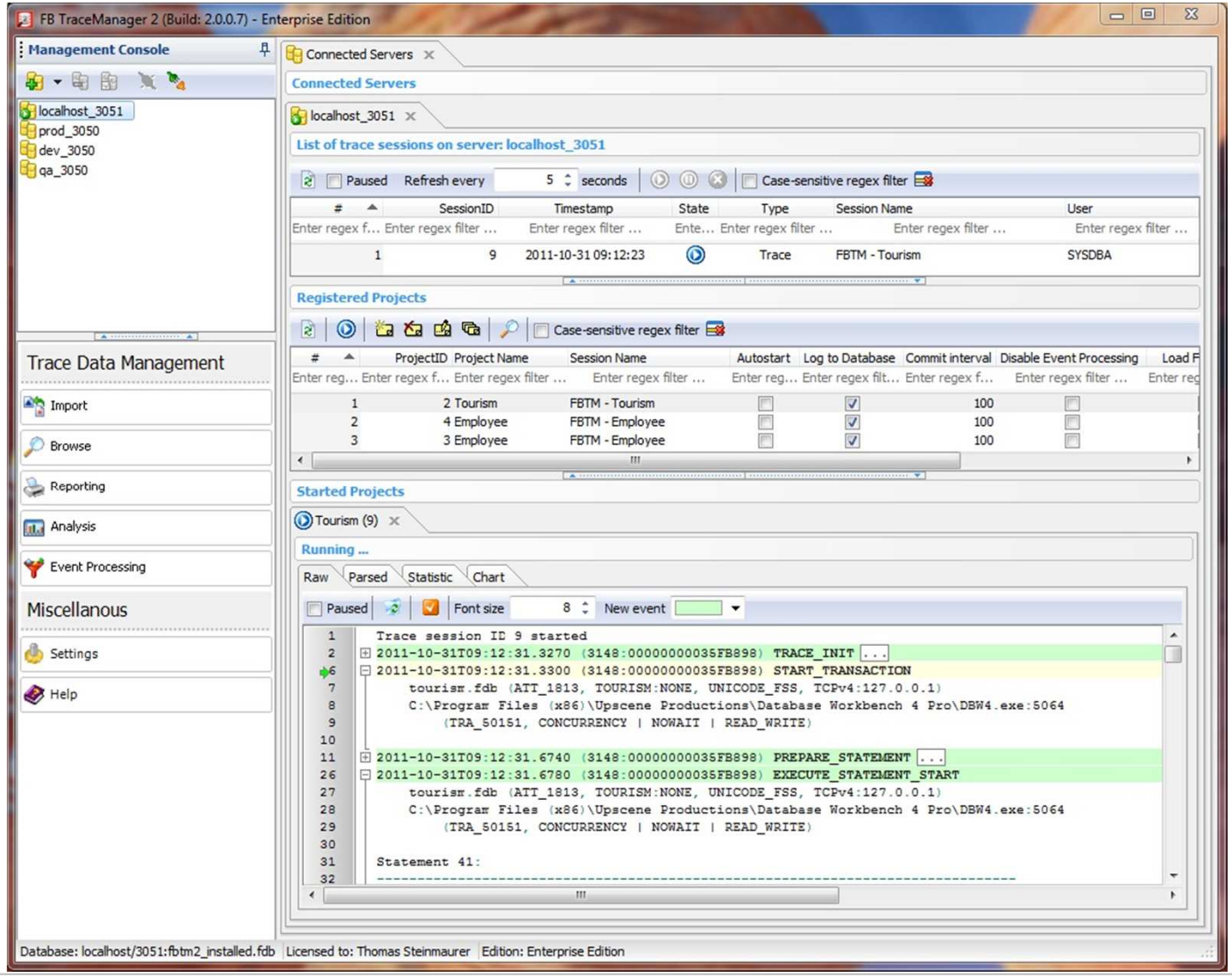

Live Demonstration

FB TraceManager 2 Editions

- Lite Edition
  - Local connections and raw trace data only
  - Freely available
- Standard Edition
  - Lite + Remote connections, Parser, Reporting
  - **99 EUR** per user named license
- Enterprise Edition
  - Standard + Analysis, Event Processing
  - **149 EUR** per user named license
- Trial Edition
  - 30 days limited Enterprise Edition
  - Limited number of received/parsed trace events

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Q&A

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Questions and Answers

The End

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Thanks for your attention!

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Resources

- Firebird 2.5 Release Notes: http://www.firebirdsql.org/devel/doc/rlsnotes/html/rlsnotes25.html
- Trace Services and Audit in Firebird 2.5, by Vlad Khorsun; Firebird Conference 2009 Munich
- Audit and Trace Services in Firebird 2.5, by Thomas Steinmaurer, 2010: http://www.ibphoenix.com/main.nfs?a=ibphoenix&page=ibp_audit_trace_steinmaurer
- FB TraceManager 2: http://www.upscene.com/go/?go=fbtm